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Ozarski

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(54) **OVERHEAD STORAGE DEVICE**

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(72) Inventor: **Robert Ozarski**, Poway, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 102 days.

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B66D 3/04 (2006.01)
B66D 1/16 (2006.01)

(52) **U.S. Cl.**
CPC ***B66D 3/04*** (2013.01); ***B66D 1/16*** (2013.01)

(58) **Field of Classification Search**
CPC B66D 3/04; B66D 1/12; B66D 1/16; B66C 19/00; B25J 9/026; B66F 7/02
See application file for complete search history.

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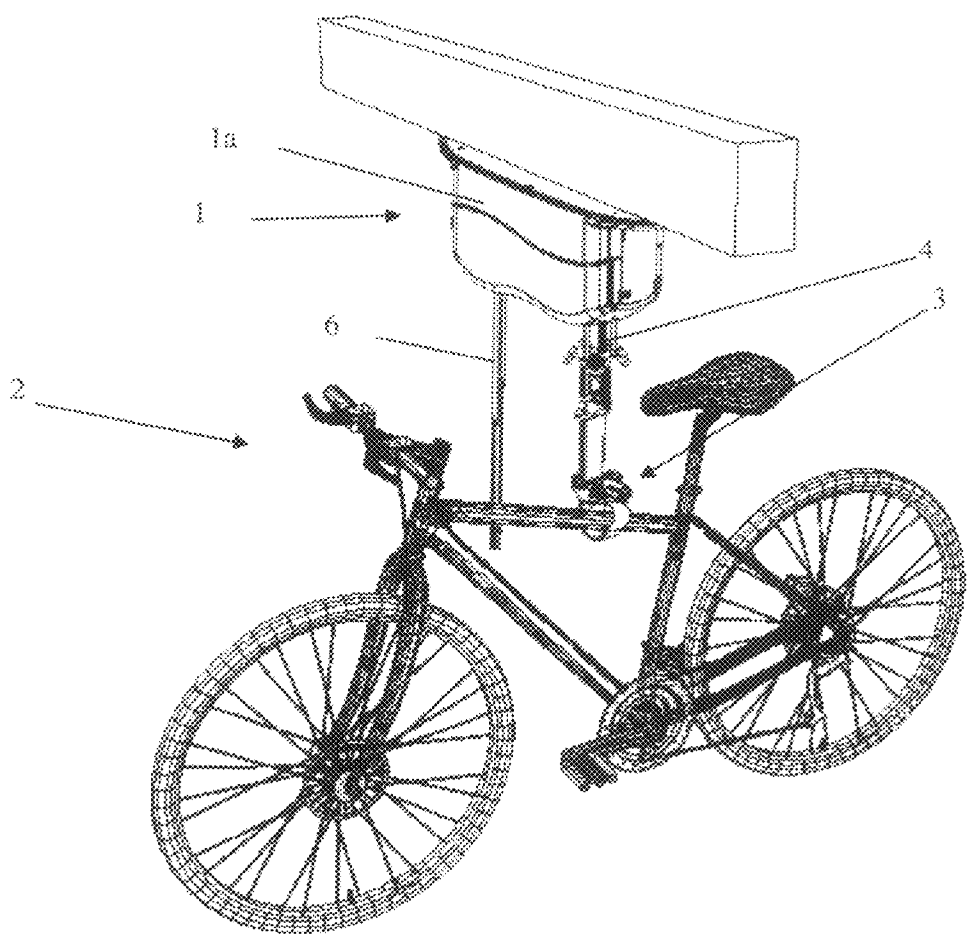
(57) **ABSTRACT**

An overhead storage device comprising a cable pulley; a constant torque spring unit attached to the cable pulley and adapted to apply an approximately constant torque to the cable pulley; a cable partially wound around the cable pulley and having an attachment mechanism at one end of the cable; and a locking mechanism; comprising a pawl, a release cord attached the pawl and a ratchet unit; adapted to permit the attachment mechanism and an attached load to be lowered and locked at any desired position within the range of the device. The device is particularly suited for storing items, such as bicycles, golf clubs and yard equipment that are commonly stored in garages.

4 Claims, 11 Drawing Sheets



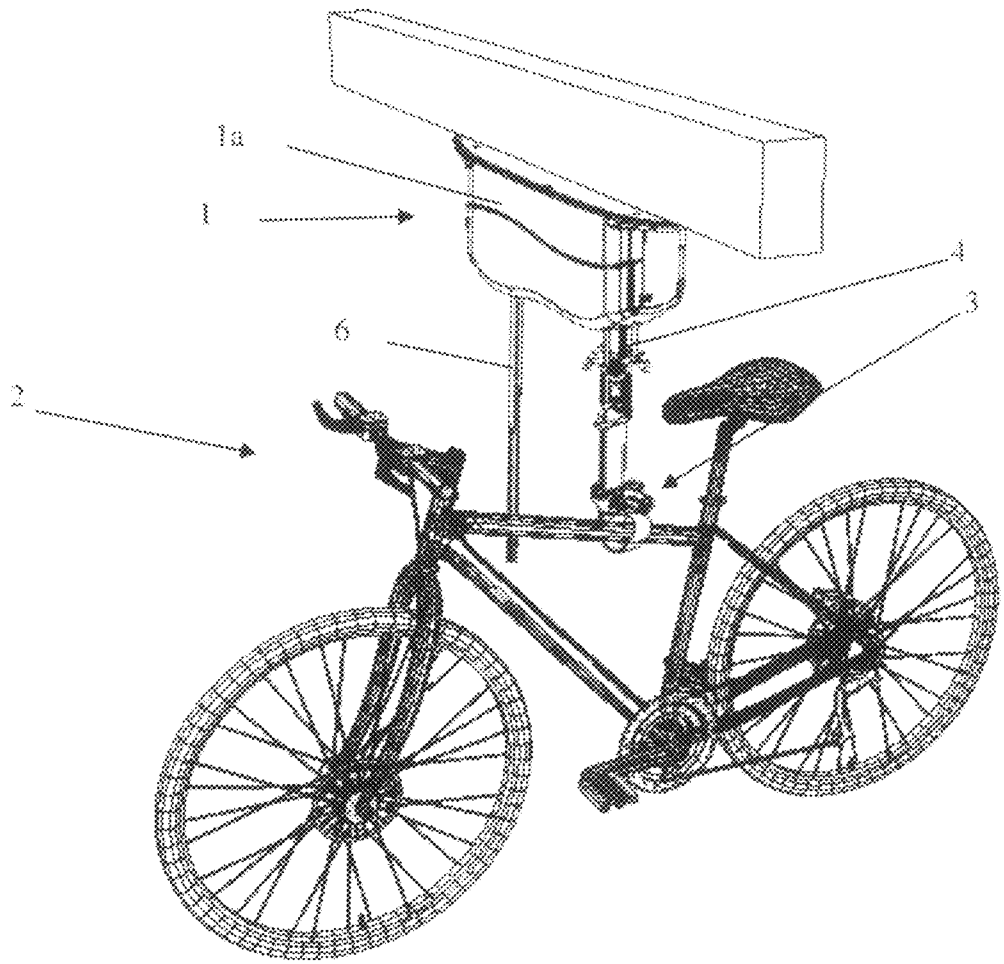


FIG. 1

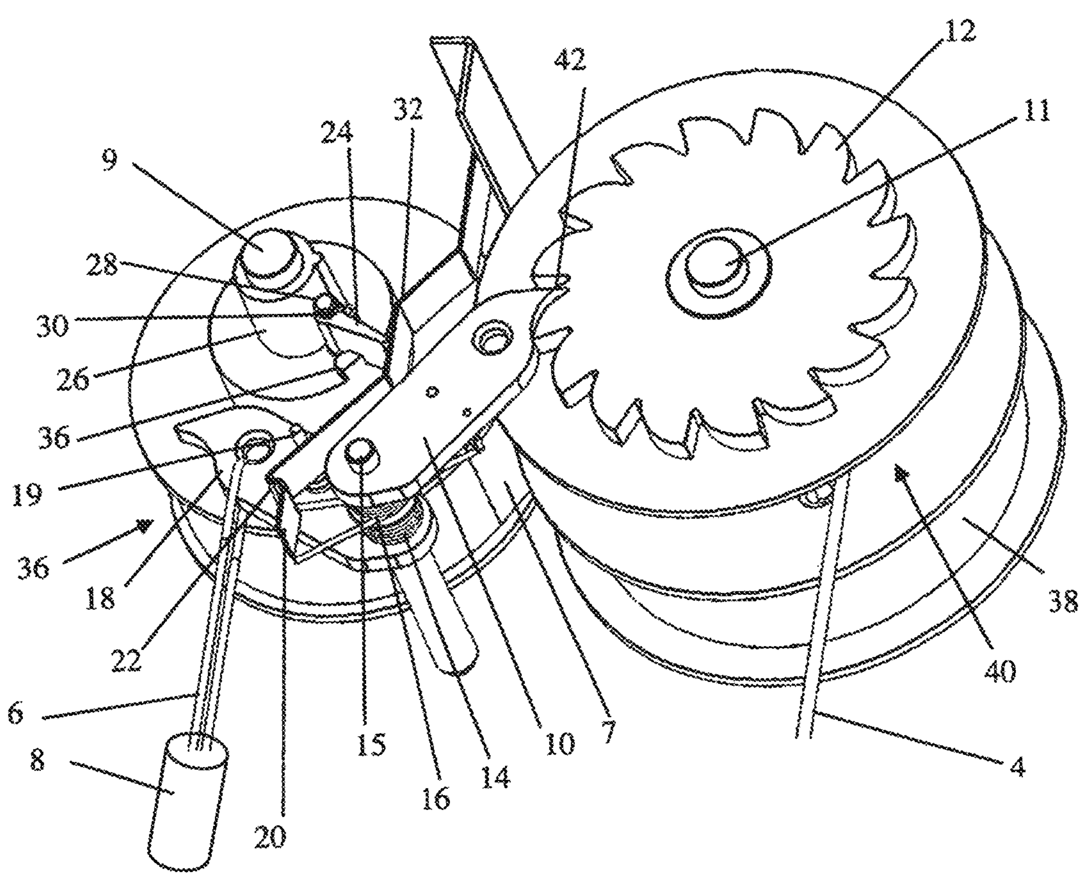


FIG. 2

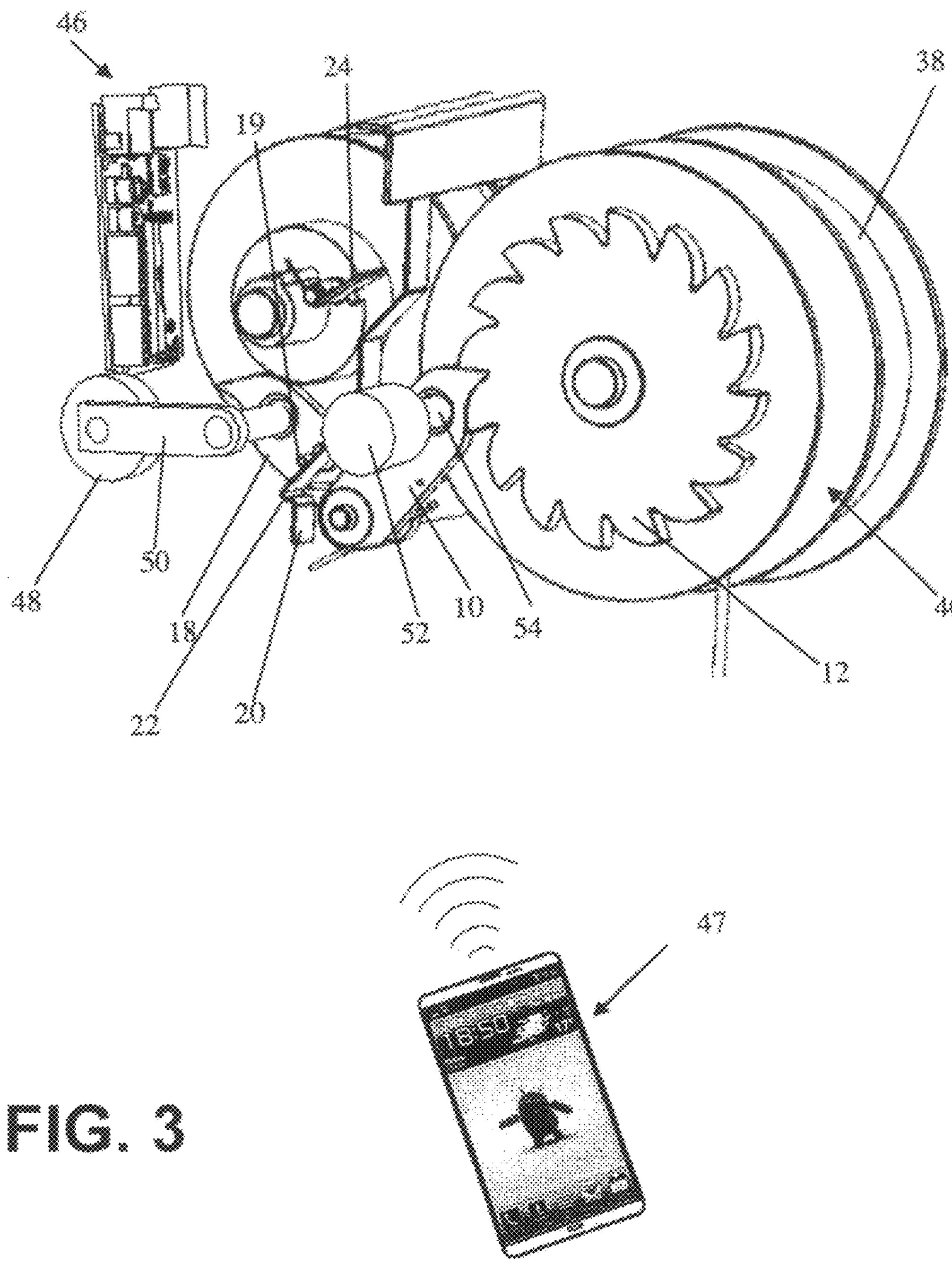


FIG. 3

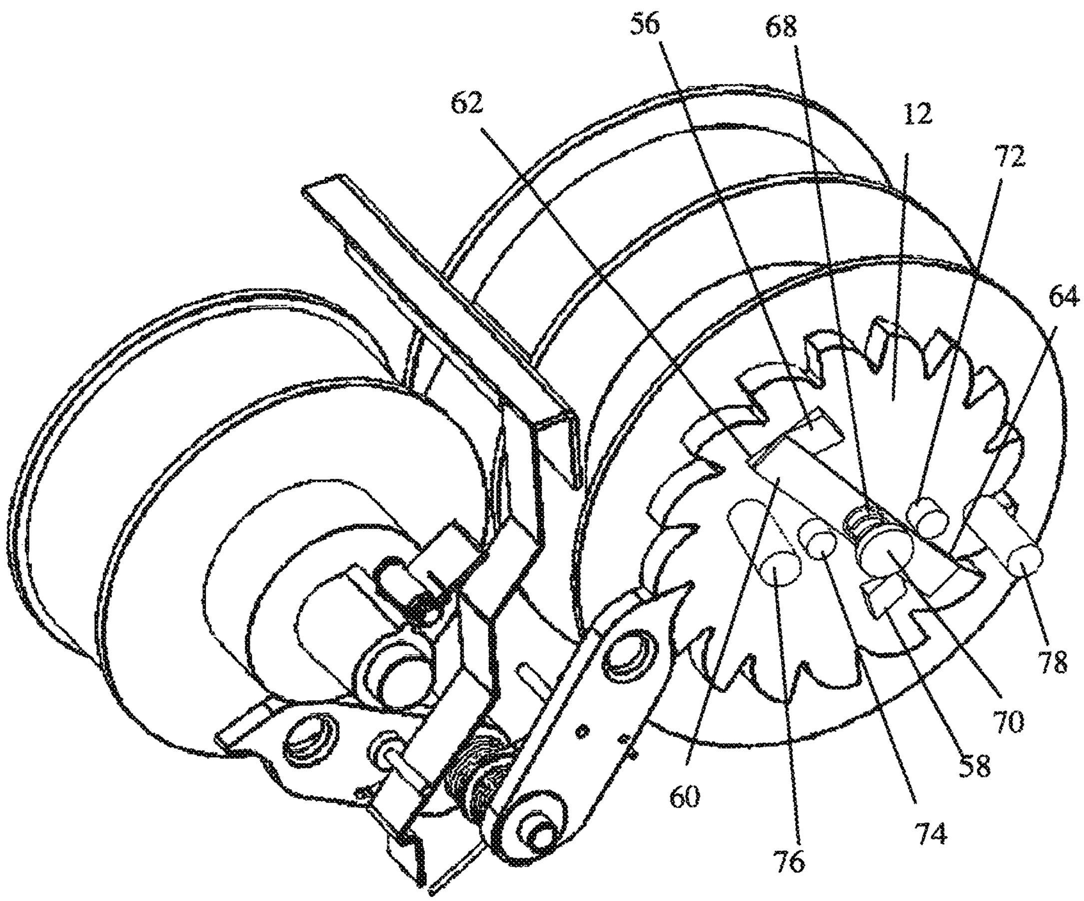


FIG. 4

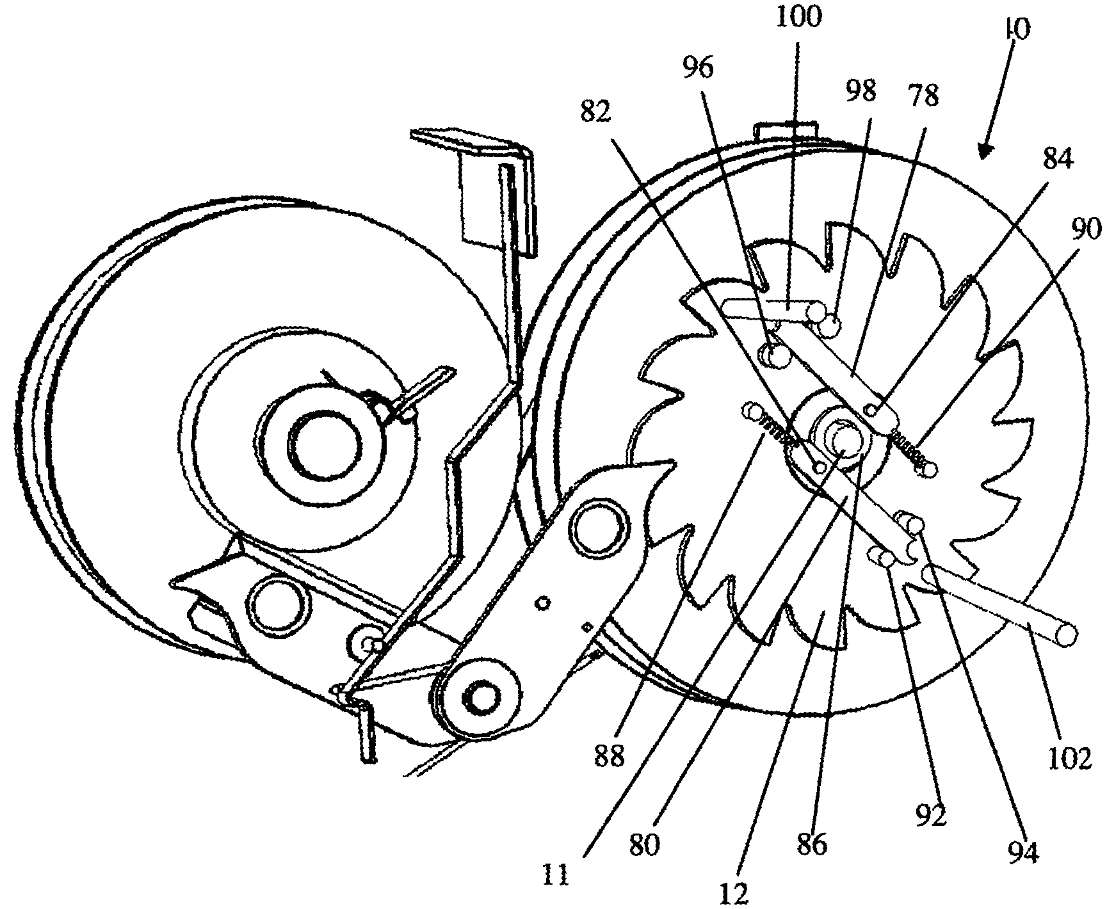


FIG. 5

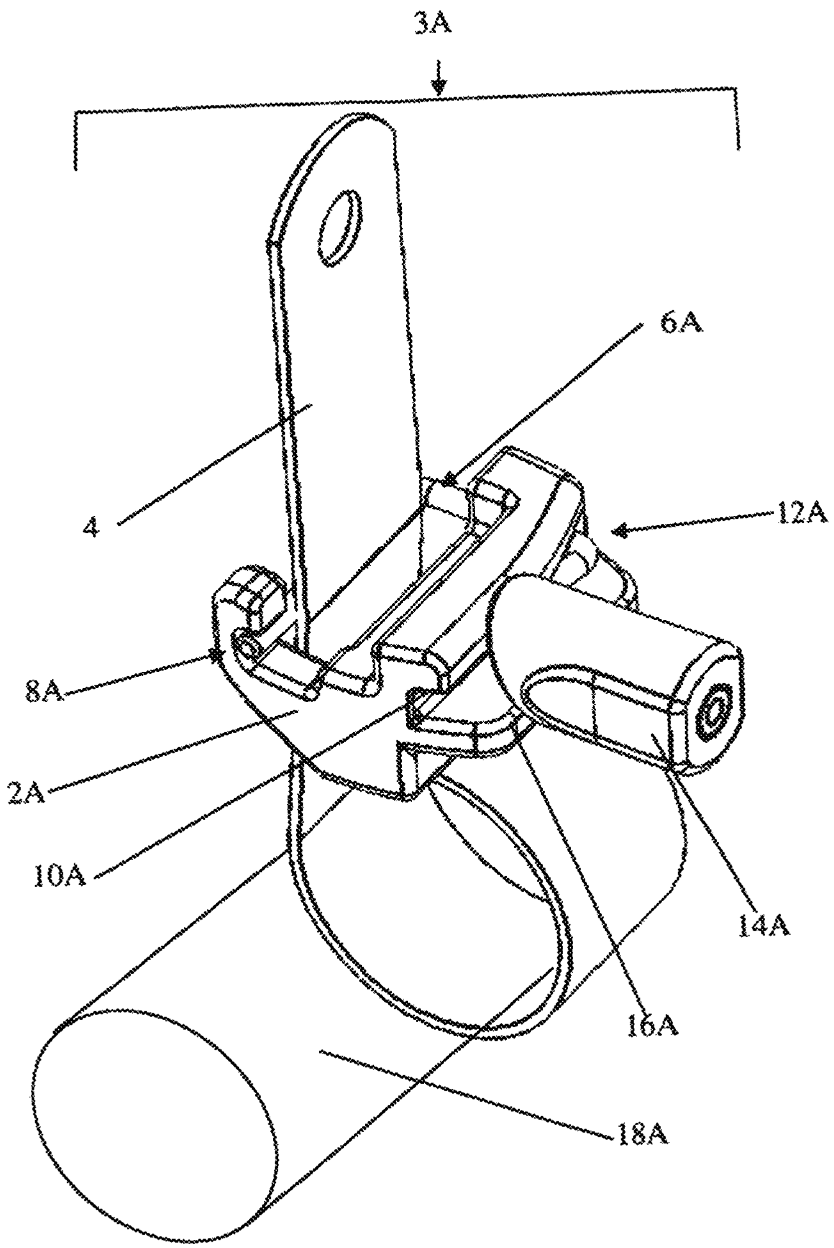


FIG. 6

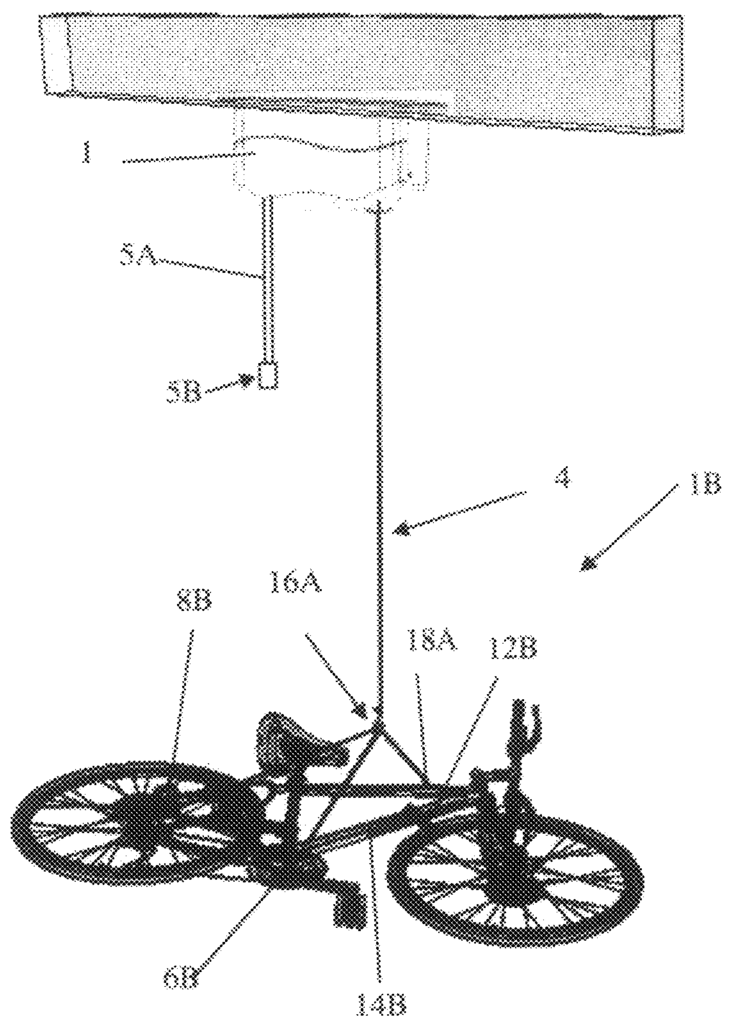


FIG. 7

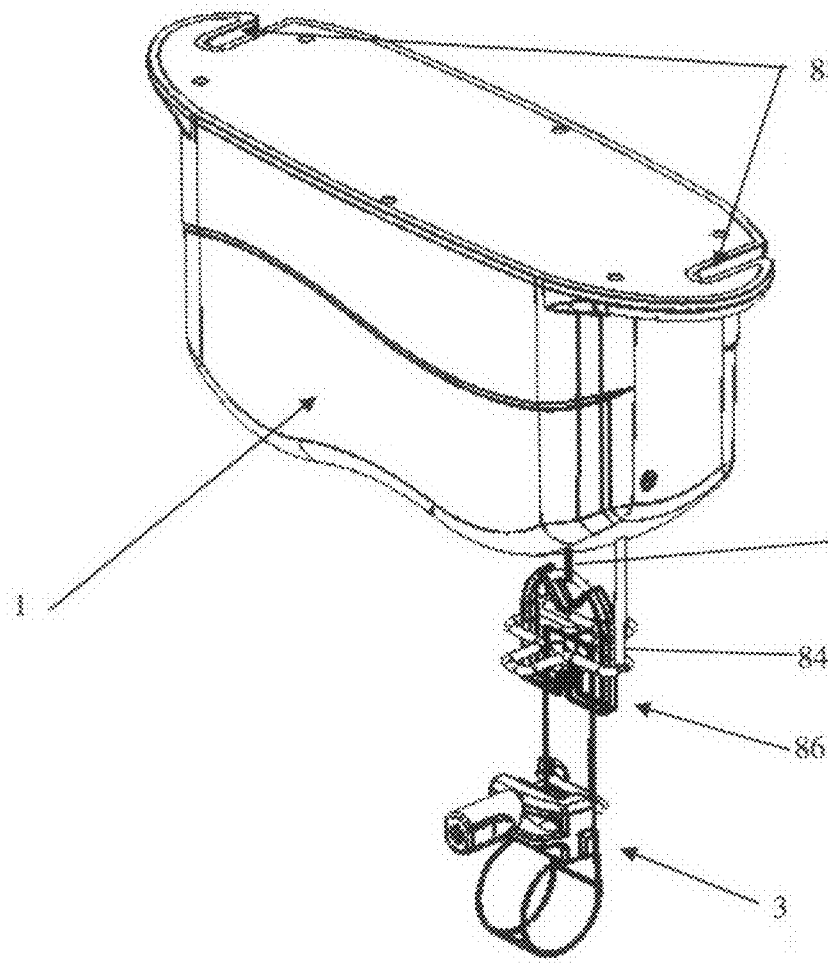
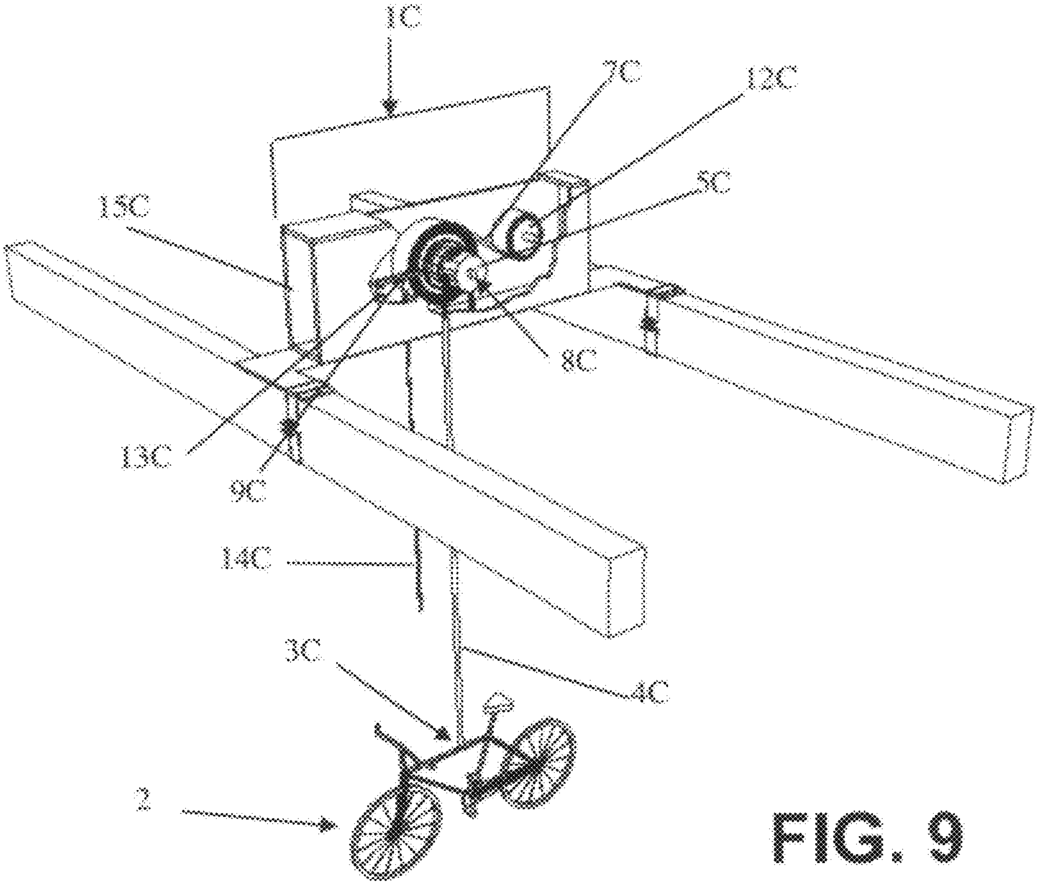


FIG. 8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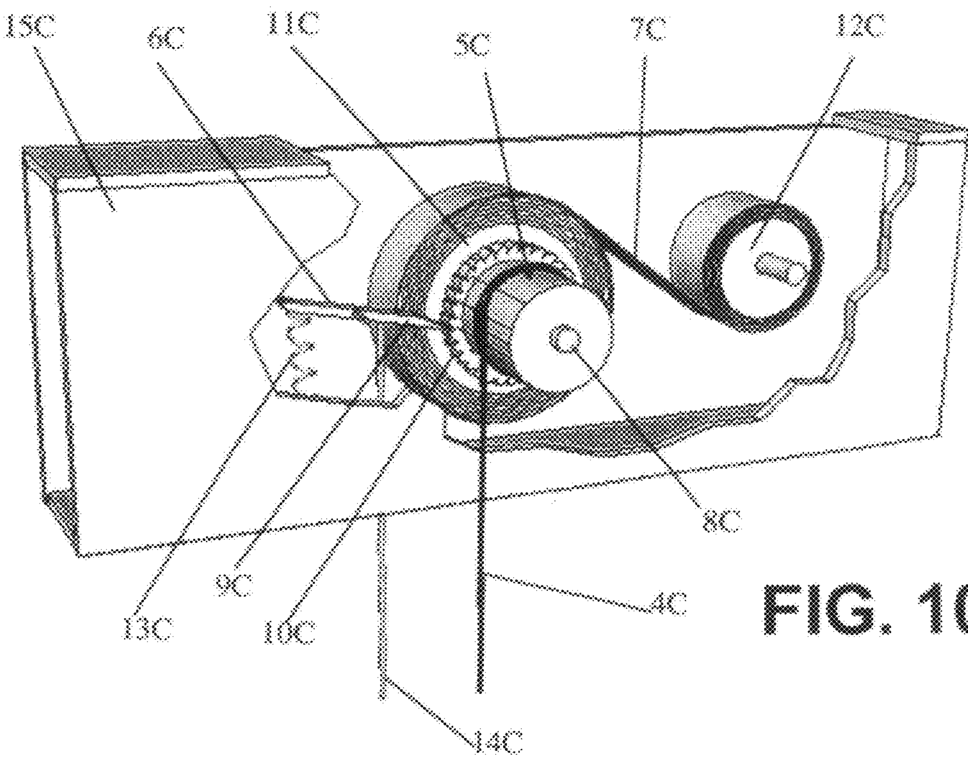
7C
12C
5C
15C
8C
13C
9C
14C
3C
4C
2

FIG. 9


15C
6C
11C
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7C
12C
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13C
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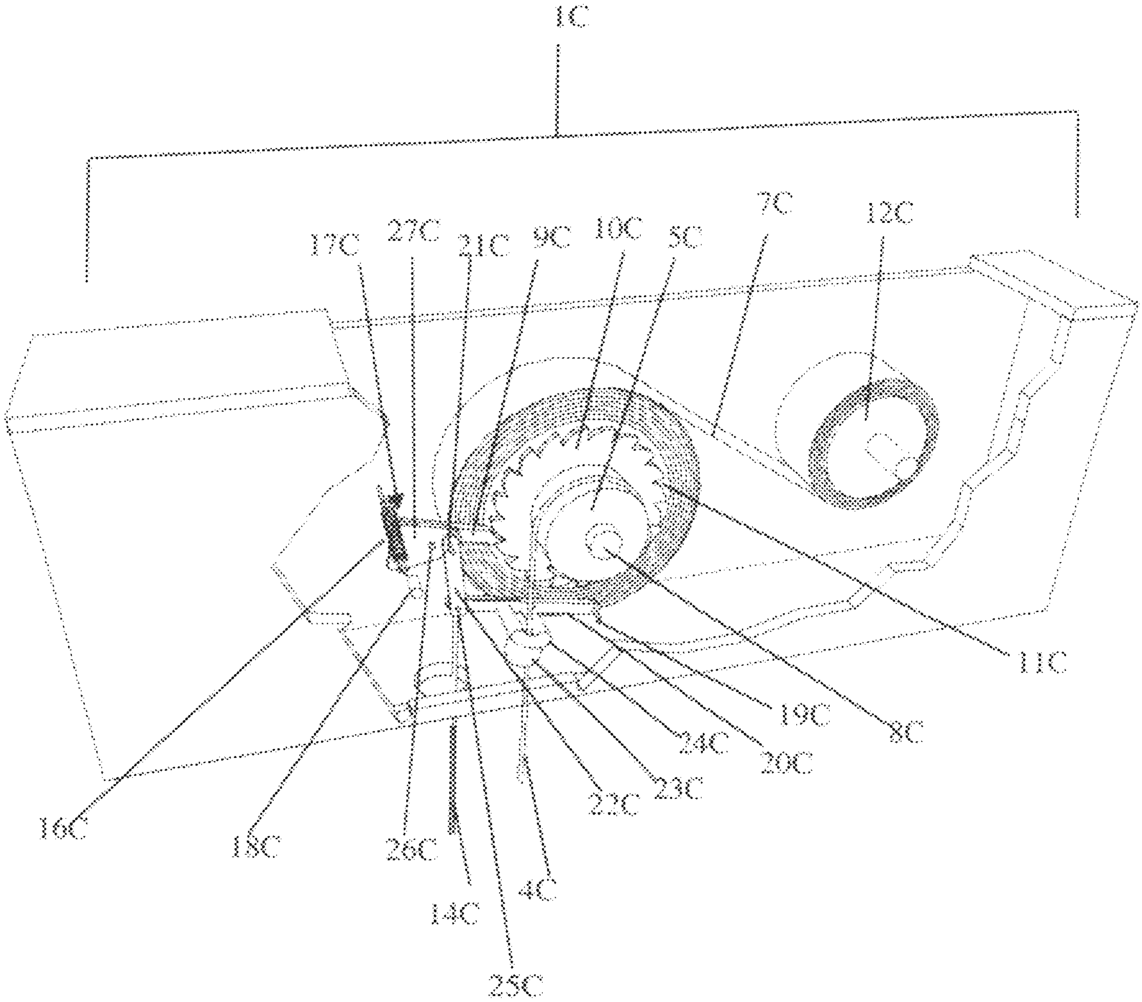
4C
14C

FIG. 10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7C
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24C
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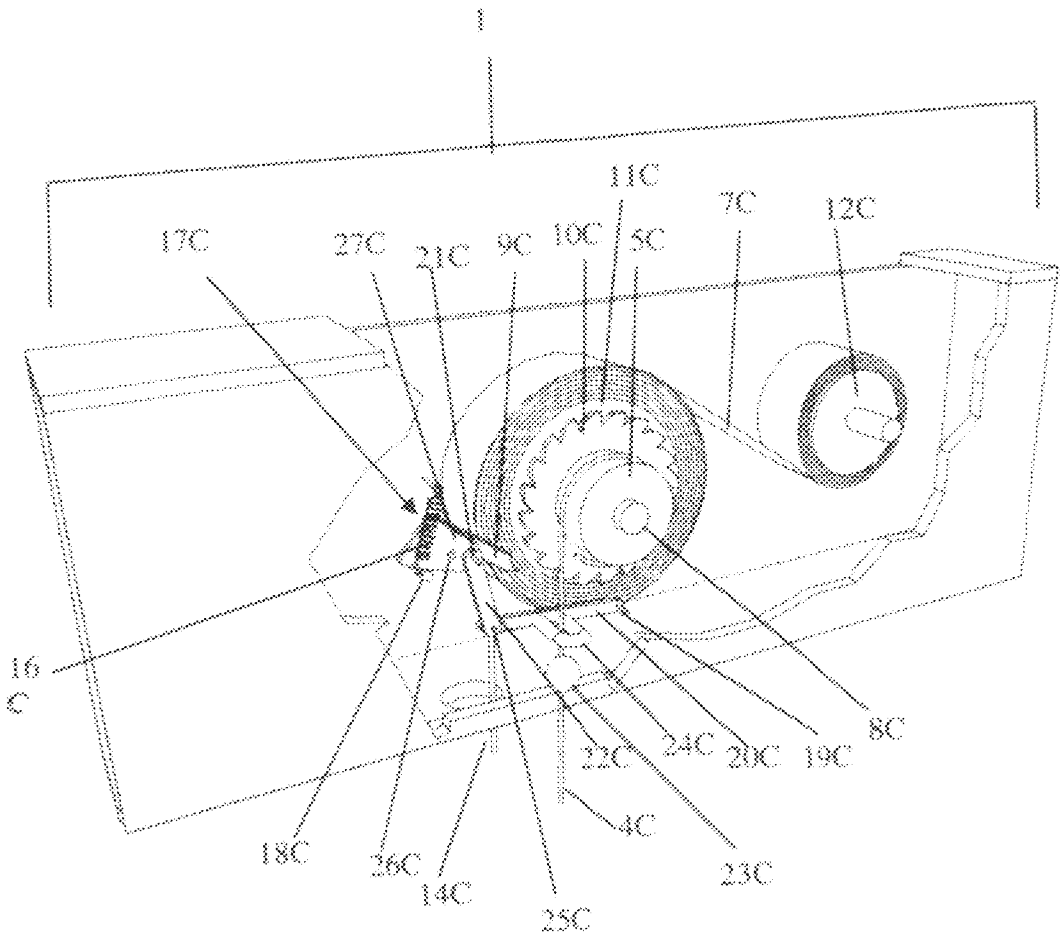
23C
22C
16C
18C
26C
14C
4C
25C

FIG. 11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9C
10C
11C
5C
7C
12C
16
C
8C
19C
20C
24C
22C
4C
23C
18C
26C
14C
25C

FIG. 12

OVERHEAD STORAGE DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation in part of U.S. patent application Ser. No. 13/235,362 filed Sep. 16, 2011, which is incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates to storage devices and in particular to overhead storage devices.

BACKGROUND OF THE INVENTION

Most families in the United States own one or more bicycles. Only a small portion of the populations regularly rides the bicycles. Most bicycles in the United States are in storage, often with flat tires and rusty chains. Many bicycle storage devices have been proposed. Many of these devices seek to store the bicycles in spaces not needed for other uses, such as up above floor spaces, for example, by hanging the bicycle from a ceiling in a garage, above normal automobile spaces. Some prior art patents covering bicycle storage include the following U.S. Pat. Nos. 3,872,972, 6,161,207, 3,907,113 and 5,183,162. U.S. Pat. No. 3,872,972 includes a rack for hanging a bicycle above the floor and a counterweight to ease the effort associated with raising the bicycle.

Prior art U.S. Pat. No. 7,370,843 discloses a retractable load support system a constant torque spring for providing an approximately constant torque to a spool arranged to lift a load like a bicycle for overhead storage and a gerotor "for dampening the raising of [the load] in a relatively fast manner which can damage the [load or the support system]. A gerotor is a special fluid pump and in this system the fluid was merely circled to dissipate energy so as to slow down the lifting of the load. The gerotor adds considerably to the cost of the system.

Constant torque springs have been around for a long time with one of their initial applications being as early as the 15^{th} century as the mainspring of wind up clocks. The oldest surviving clock powered by a mainspring is the Burgunderuhr (Burgundy Clock), an ornate, gilt chamber clock, currently at the *Germanisches Nationalmuseum* in Nurnberg, whose iconography suggests that it was made around 1430 for Philippe the Good, Duke of Burgundy.

What is needed is a better overhead storage device.

SUMMARY OF THE INVENTION

The present invention provides an overhead storage device. The device is particularly suited for storing items commonly stored in a garage, such as bicycles, golf clubs, and yard equipment, which occupy floor space and often exclude the ability to park an automobile in the garage. In particular the device includes a mechanism for hoisting the object to be stored such as a bicycle above floor level. The device includes a cable with an attachment mechanism at one end of the cable. The cable is partially wound on a spool. A constant torque spring applies an approximately constant torque to the spool. This approximately constant torque continuously causes the cable, unless restrained, to be further wound on the spool. The device includes a special locking mechanism which allows the attachment mechanism and an attached load to be lowered and locked at any desired position within the range of the device. In preferred embodiments the locking mechanism includes a pawl and ratchet unit adapted to restrain any lifting of the load unless a release cord attached to a release arm is pulled which is connected to the pawl by a torsion spring. An alternative to the manual release is the use of a WiFi operated microcontroller which is controlled through the WiFi connection to a smart phone or a WiFi network device. The action of the release arm causes a rotational force to be applied to the pawl which initiates step one of a two step release process. The second step requires a downward force to be applied to the load such that it descends slightly. This second action causes the pawl to unlock from the ratchet allowing the load to ascend. This two step feature prevents an accidental release of the locking mechanism. Such an accidental release could damage the load and/or the storage device.

Bicycles provide a unique challenge to attach to a lifting storage device, as they have a large variety of shapes, sizes and angles of their cross bars. Modern bikes are very expensive with some costing upwards of $10,000 and composed of materials ranging from bamboo to carbon fiber. The invention describes an attachment device which accommodates this wide range to hold them securely, without causing any damage. In particular the load attachment device must hold the bicycle along its cross bar which may be angled significantly without sliding along it as the bicycle is raised.

Preferred embodiments of the present invention include a cable pulley; a constant torque spring unit attached to the cable pulley and adapted to apply an approximately constant torque to the cable pulley; a cable partially wound around the cable pulley and having an attachment mechanism at one end of the cable; and a locking mechanism adapted to permit the attachment mechanism and an attached load to be lowered and locked at any desired position within the range of the device; wherein the approximately constant torque applied by the constant torque spring continuously causes the cable, unless restrained, to be further wound on the cable pulley. Applicant's use of the phrase "approximately constant torque" of a constant torque spring is meant to refer to torque that varies by less than plus or minus 10 percent over the range of the spring.

A preferred locking mechanism is a pawl and ratchet unit which preferably includes a release cord connected to the pawl such that the pawl and ratchet unit restrains rotation of the spool unless said release cord has been pulled downward with a downward force and the load is simultaneously pushed slightly downward. Preferred constant torque spring units include a constant torque spring, an output spool, and a storage spool, wherein said spring is wrapped around said output spool and said storage spool in reverse directions so as to create a nearly constant torque on said output spool and said cable pulley. Preferred embodiments also include a holding feature for holding said locking mechanism in an unlocked position while said cable is wound around said cable pulley and while a load is raised and load release feature for allowing the raising and lowering of a load.

Preferred embodiments may also include a centrifugal clutch for stopping rotation of said cable pulley during rapid acceleration of said cable pulley and in some applications the release cord is a loop and can be used as a means of raising the lift cable when it is not in use to lift a load. Features are also provided for storing bicycles is horizontally as well as vertical. A special bicycle attachment feature is described which includes a rubber coated strap designed to minimize any damage to expensive bicycles in the course of storage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1-2** show a preferred embodiment of the present invention.

FIG. **3** show another preferred embodiment of the present invention using WiFi activation.

FIG. **4-5** shows another preferred embodiment of the present invention using a clutch mechanism to control the maximum rate of ascent.

FIG. **6** shows another preferred embodiment of the present invention to securely hold a bicycle while being lifted by the device.

FIG. **7** shows another preferred embodiment of the present invention, which allows a bicycle to be stored horizontally.

FIG. **8** shows a preferred bike load attachment device, orientation and adjustable height stop.

FIG. **9-10** show an alternate mechanism embodiment for the present invention.

FIG. **11-12** show an alternate mechanism of the present invention for causing the ascent of the load without continuously pulling he release cord during the loads ascent.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. **1** shows a bicycle storage device **1**, which allows a bicycle to be lifted by a constant torque spring mechanism and pulley system of FIG. **2**, from its standing position on the ground to a position at the top of the lifting device's travel for storage. A bicycle **2** or other load is attached by a load attachment device **3**, as shown in FIG. **1** to a lift cable **4** suspended by the device's cable pulley **40** of FIG. **2** which is mounted in the containment and support case **1**A of FIG. **1**, through a shaft **11**, shown in FIG. **2**. A constant torque spring **7**, supplies a force slightly greater than the weight of the object load (bicycle), such that the load object will rise until the maximum lift height is reached or the object reaches the ceiling. A preferred constant torque spring is available from Vulcan Springs, Inc. with offices in Telford, Pa. The object load (bicycle) is lowered by manually applying a small amount of downward force, by pulling downward on the object load attached to the load attachment device **3** of FIG. **1**. As the object load **2** (a bicycle) of FIG. **1** is lowered a pawl **10** will rotate counterclockwise and ratchet **12** will rotate clockwise, shown in FIG. **2** allowing the bicycle to descend by rotating but when the downward pull is stopped the load object will tend to rise due to the torque applied to it by the constant torque spring **7**, turning the cable pulley **40** in a counterclockwise direction. This will cause the pawl **10** to engage the ratchet **12** due to the clockwise force applied to it by torsion spring **16** mounted around axel **15** with one end attached to pawl **10** and the other held by the containment and support case. Thereby preventing the cable pulley **40** from turning and the load from rising. The pawl **10** is positioned such that an arc from its pivot position with a radius equal to the distance from the pivot to the pawl apex **42** will intersect the circumference of the ratchet teeth, root circle. The position at which the pawl **10** stops the rotation of the ratchet **12** is where the lower intersection of the two circles occurs. This action allows the load to be stopped at any point in its travel, when the downward force applied by the user is stopped. With the pawl **10** engaged into the ratchet **12**, the object load, such as a bicycle, can be removed from the load attachment device **3** of FIG. **1**. The load attachment device **3** remains at whatever height above the floor it was positioned at. The lift cable **4** is wound around the cable pulley **40**, as shown in FIG. **2**, to which the lift cable **4** is attached and connected by a shaft to the output spool **38** of the constant torque spring **7**. The constant torque spring mechanism, is comprised of the containment and support case **1**A of FIG. **1** and a constant torque spring **7** of FIG. **2**, which is wound around two spools. The output spool **38** and the storage spool **36**, as shown in FIG. **2**, which are supported by their respective axle shafts **11** and **9**. A portion of the constant torque spring is coiled about the output spool **38** and a portion about the storage spool **36** in the reverse rotation. This reversal of the winding from the output spool **38** to the storage spool **36** creates a nearly constant torque (+/−10%) on the output spool **38**, which is transferred to the cable pulley **40** by its connection to the output pulley **38**. The torque transferred to the cable pulley **40** generates a force which tends to wind the lift cable **4** about the cable pulley **40** and thereby lift the load of the attached bicycle or other object, within the lifting limits of the torque, which is supplied by the constant torque spring **7**.

The constant torque spring **7** is designed such that the torque it generates in combination with the radius of the cable spool **2** produces a force, which is slightly greater than the weight of the intended load (bicycle for example) to be lifted. The maximum lifting capability is determined by the proper choice of the spring parameters, spool diameters and the cable pulley's diameter. For a given constant torque spring, the lifting torque and thereby the load lifting capability of the device can be adjusted to suit the intended load by adjusting the diameter of the cable pulley **40**. This can be accomplished in a variety of ways, for example by replacing the spool with a suitable diameter for the load, by adding or removing a cylindrical sleeve to the base cable pulley **40** to increase its diameter, or by winding a material about the spool upon which the lifting cable rides on top of, thereby increasing the effective diameter as experienced by the lifting cable **4**. The spring mechanism provides a nearly constant torque (+/−10%) independent of the number of turns on the output and storage spools; this creates a nearly constant force on the lift cable, which is always tending to lift the object load. To lower the load a downward force is applied by the user which overcomes the constant torque spring force applied to the cable pulley **40** such that it unwinds the lift cable **4**, causing the load to descend. This will wind further turns of the constant torque spring **7** onto the output spool **38** as the load is lowered. In normal operation the constant torque spring **7** is coiled about the storage spool **36** with only a few turns about the output spool **38**. As the load is lowered, from its uppermost position, it winds an increasing portion of the constant torque spring **7** about the output spool **38**, which supplies torque to the cable pulley **40** and thereby provides a force to resist the weight of the object load, attached to the lift cable **4**, in affect counter balancing it. During lowering of the load, the pawl **10**, is not engaged into the ratchet **12**, attached to the cable pulley **40**, but rides along the top edge of the teeth of ratchet **12** as it rotates clockwise. When the load reaches the desired height and the downward force applied by the user is released, the pawl **10** and the cable spool **40** will tend to rotate counter clockwise due to the force of constant torque spring **7**. This will cause a tooth of the ratchet **12** to engage into pawl **10** preventing it from turning counter clockwise and thereby any upward travel of the lift cable **4**. This locking action allows the load to be lowered to any desired height and removed from the load attachment device **3**, shown in FIG. **1**, at any position along its travel.

In order for the device to lift a load, the pawl **10** must be disengaged from the ratchet **12** to ride on top of the teeth of ratchet **12** when lowering a load. This is accomplished in the following manner. The pawl **10** is free to rotate about axle **15**. A torsion spring **16** is mounted around axel **15**. One end of it is attached to pawl **10**. The other end is attached to the containment and support case 1A. The torsion spring **16** tends to rotate the pawl **10** clockwise, about axle **15**, thereby tending to hold it in contact with ratchet **12**. A release arm **18** is also mounted on the axle **15** and is free to rotate about it. A second torsion spring **14**, is mounted on axle **15**. One end of spring **14**, is affixed to release arm **18**. The other end of spring **14** is affixed to pawl **10**. The spring **14** is positioned such that when pawl **10** is engaged in ratchet **12**, there is no tension due to spring **14** between the pawl **10** and the release arm **18**. When release cord handle **8**, is pulled downward it causes the end of spring **14**, attached to release arm **18** to coil about axel **15** thereby applying tension in a counterclockwise direction to pawl **10**. When pawl **10** is engaged in ratchet **4**, the tension of the constant torque spring **7**, causing counter clockwise tension on the ratchet **12**, keeps the pawl **10** engaged in ratchet **12** preventing it from rotating out from under a tooth of ratchet **12**. As release arm **18** rotates counterclockwise, due to the pulling down of release cord handle **8**, the latch pin **19** affixed to pawl **10** will rotate with it. It will contact flat latch spring **20**. This will cause the latch spring **20** to deflect to the right. As latch pin **19** rotates further counter clockwise, it will pass under latch point **22** of flat spring **20**, which is a step in flat spring **20**. As the user stops pulling on the release cord handle **8**, the release arm **18** will rotate clockwise due to spring **14**. The latch pin **19** will catch under the latch point **22** and prevent it from rotating clockwise further. This will hold release arm **18** in a rotated position and applying a counterclockwise force to pawl **10**. Spring **14** and spring **16** are chosen such that the net torque on pawl **10** is counterclockwise, when release arm **18** is rotated and latched into latch point **22**. Since the pawl **10** is engaged in the ratchet **12** and is therefore unable to rotate counter clockwise, due to the counterclockwise torque applied to the ratchet **12**, by the constant torque spring **7**, it will remain trapped in a tooth of ratchet **12** and the cable spool **40** will not rotate to raise the load. This condition exists as long as the force of the load attached to the lift cable **4** tending to rotate the cable spool **40** and hence the attached ratchet **12** clockwise, is less than the torque tending to rotate the ratchet **12** clockwise by the constant torque spring **7**. This is the condition when a load is attached to the lift cable ready to be raised or in its stored position. In order to raise the load in addition to pulling the release cord handle **8**, the pawl **10** must be disengaged from the ratchet **4**. This is accomplished by first pulling the release cord handle **8** causing the latch pin **19** to be trapped under latch point **22**, as described above. Thereby applying a counter clockwise torque on pawl **10** tending it to rotate counter clockwise to come out from a tooth of ratchet **12**. The user then must momentarily increases the downward force of the load by exerting an additional downward force, causing the load to descend slightly and the cable spool **40** to rotate slightly by one tooth of the ratchet **12**, clockwise which allows pawl **10** to disengage from ratchet **12**, due to the net torque applied by springs **14** and **16** counter clockwise. The angle through which the release arm **18** has been rotated when latched is chosen such that it causes the pawl **10** to rotate sufficiently that it becomes clear of the teeth of ratchet **12** and no longer can prevent ratchet **12** from rotating counterclockwise, as long as the release arm **18** is latched by latch point **22**. Under this condition the load will ascend until it is either stopped by some portion of it reaching the ceiling, the bottom of the device containment and support case or the device docking collar **86** into docking cradle **84**, shown in FIG. **8**. It will remain there under upward tension.

During the loads ascent, cam base **26** shown in FIG. **2**, attached to storage spool **36** will rotate clockwise. The cam arm **24** is mounted about hinge pin **28** on cam base **26**. A cam torsion spring **30** is also installed around pin **28**, which rotates cam arm **24** clockwise against cam stop **36** which keeps it pointed in the radial direction. As the storage spool **36** and the attached cam base **26** rotates clockwise for a descending (opposite the direction of the output spool **38**) load, cam **24** contacts the latch spring **20** release point **32** on each rotation. The cam spring **30** will be compressed by the contact of cam **24** with the latch spring **20** on each rotation but the spring force of spring **30** is chosen such that the cam **24** will rotate counter clockwise about pin **28** toward its base **26** and not deflect the latch spring **20**, as it passes over the release point **32**, in a clockwise direction. Therefore, the release pin **19** of release arm **18** remains latched in latch point **22**, allowing the load to ascend, as cable **4** winds about cable spool **40**. For descent the release arm **18** needs to be reset to it original unlatched position, applying no tension on pawl **10**. This is accomplished as follows. When it is desired to lower the load, the user pulls downward on the load attached to the lift cable **4**, overcoming the upward torque of constant torque spring **7**. As the load descends cam base **26** will rotate counterclockwise. As cam **24** rotates with its base **26** counterclockwise, its tip will contact release point **32** of flat spring **20**. Because cam **24** is restrained by stop point **36** from rotating clockwise about pin **28**, it will push against flat spring **20** and cause it to deflect to the right, as shown in FIG. **2**. As it defects to the right it will allow latch pin **19** to come out from under latch point **22**. This will relieve the counterclockwise net force on pawl **10** due to springs **14** and **16** and result in a clockwise force due to spring **16** alone. This will rotate pawl **10** clockwise into ratchet **12**, which it was held away from. This is the desired condition during descent such that at any point during its descent when downward force applied by the user is discontinued, the load will stop its descent and stay in the position it was released, as pawl **10** engages a tooth of ratchet **12**, when the load tries to rise due to constant torque spring **7** tending to rotate ratchet **12** counterclockwise. This restores the initial condition whereby the load can be lowered and will remain at any intermediate position, whenever the force exerted by the user to lower the load is discontinued.

A feature of preferred embodiments of the storage device is its ability to be easily mounted using mounting slots **8**, as shown in FIG. **8**. Two lag screws are partially screwed into a ceiling joist in the position spaced apart the distance between the slots **88**. The slots **88** in the containment and support case are slid over the lag bolts and tightened to complete installation.

An additional feature is the docking cradle **84**, shaped like an open cross mounts into the support containment and support case and is height adjustable, as shown in FIG. **8**. A connecting docking collar **86** is affixed to the bicycle attachment device **3** and the other end affixed to the lifting cable **4**. The docking collar **86** is shaped to mate into a section of the docking cradle **84**. When mated with the docking cradle, the docking cradle stops the load from ascending further. It also prevents the attached bicycle from rotating and keeps any portion of the bicycle from contacting the ceiling or the containment and support case 1A of FIG. **1**, thereby preventing any scratching or marring of the bicycle.

The cross shape of the docking cradle **84** of FIG. **8**, allows the bicycle when ascending to its stored position to be docked into either opening of the docking cradle cross. Therefore as the bicycle attached to the attachment device **3** is raised it can be oriented either parallel or perpendicular to the long axis of the containment and support case. This means that although the containment and support case **1**, is necessarily mounted along the long axis of a ceiling joist, the bicycle can be oriented either parallel or perpendicular as desired for convenient storage.

An additional feature of preferred embodiments is the release cord **6** of FIG. **2** which attached to the handle **8** is a loop through release arm **18**. Therefore when there is no load attached the end of the lift cable, the attachment device **3** can be hooked onto the handle **8** of the release cord **6**. One side of the release cord loop can then be pulled to rotate it which will in turn raise the handle **8** and the end of the lift cable, to form a loop, such that its end is substantially moved up and out of the way when no load is attached to it. When it is desired to attach a load, the loop formed by the lift cable between the cable spool and release cable handle is pulled which brings the attachment device and handle back down, where it can be detached from the release cable handle and attached to the load.

Alternate Method of Releasing Using WiFi

An alternate method of performing the function of the release cord **6** of FIG. **2** is shown in FIG. **3**. In this method the release cord is replaced by a rotary solenoid **48**. An arm **50** affixed to the solenoid **48** is connected to the release arm **18** by a rotary joint. The solenoid **48** is actuated by a WiFi controller **46**, such as, an Arduino SainSmart UNO, ATmega328P and a CC3000 WiFi chip. In operation the Arduio controller **46** receives a WiFi signal from a software application running on a smart phone **47**. The user selects a command in the application running on the smart phone, which sends a WiFi signal instruction to the Arduino controller **46**. The primary commands are Lift, Unlock and Lock although others may be programmed for other functions, such as alerting a user, on their smart phone, if the bicycle is tampered with by someone unauthorized. When a Lift command is received by the Arduino controller, it is programmed to actuate the solenoid **48** to rotate arm **50** clockwise sufficiently to cause the latch pin **19** to be trapped under latch point **22**, as occurred when the release cord **6**, in FIG. **2** was used, as described previously. The solenoid actuated momentarily then deactivated but the latch pin **19** remains trapped under latch point **22**. This will hold the release arm **18** rotated in a counterclockwise position. As previously described for the case where a release cord **6** of FIG. **2** was used to allow a load to be raised. As before, the user must perform a second action of applying a downward force in addition to the load to cause the load to descend slightly and pawl **10** to disengage from ratchet **12**, shown in FIG. **3** and remain clear of it while release arm **18** is held rotated by latch pin **19**. This then allows the constant torque spring force to cause the load to ascend, as previously described. The load will rise until some portion of the load reaches the ceiling, the docking collar or the device containment and support case **1** of FIG. **1**, where it remains under tension. As the load is lowered by applying a downward force, which overcomes the spring torque applied by constant torque spring **20** of FIG. **3**, it will descend. This will cause cam **24** of FIG. **3** to contact flat spring **20** of FIG. **3** causing the flat spring **22** to deflect to the right allowing latch pin **19** to disengage and both pawl **10** and release arm **18** to rotate back to their original positions due to the net force of torsion springs **14** and **16** of FIG. **2**. This allows pawl **10** to be held against ratchet **12** but ride along the teeth during the clockwise rotation of load descent. The load will continue to descend as a sufficient additional force is applied to overcome the torsion spring force of spring **7**. When this downward force, applied by the user, is discontinued the load will be stopped at its current position by the action of pawl **10** engaging in a tooth of ratchet **12**. Descent can be resumed by continuing to exert additional downward force by the user. To reinitiate ascent of the load, the smart phone application must again be used to send a Lift command to the Arduino controller **46** to cause arm **50** to rotate clockwise and begin the latching sequence again.

To prevent an unauthorized person to access the load by lowering it a second latching solenoid **52** is affixed to the containment and support case. When a Lock commanded is issued from a users smart phone a solenoid shaft **54** extends into pawl **10**. This prevents pawl **10** from rotating in any direction, which prevents ratchet **12** and cable spool **40** from rotating, preventing the load from descending or ascending. When an Unlock command is issued from the authorized smart phone, the solenoid shaft **54** will retract from pawl **10** and allow it to rotate counterclockwise as the load descends. The Unlock command is always automatically sent when a Lift command is issued. The Lock command is selected and issued by the user from their authorized smart phone to cause the solenoid to engage shaft **54** into pawl **10**, when it is desired to lock the load in its raised or any intermediate position.

The authorization of a smart phone is part of the application software which allows the user to pair their smart phone with a particular device and set a password so that only their phone will cause the controller **46** to accept commands.

Centrifugal Brake

The constant force spring in normal operation counter balances the weight of the load and the user moderates the speed at which it rises. However, in the event that the user does not hold onto the load to moderate its rate of rise, it can accelerate and strike the device causing it or the load to be damaged. This can also occur if the pawl **10** were to fail or somehow become disengaged from the ratchet **12** shown in FIG. **2**. To prevent too rapid an ascent a centrifugal brake may be used. Under rapid acceleration the centrifugal brake, as shown in FIG. **4** would engage and stop rotation. The operation of the centrifugal brake is as follows. A rotating surface, such as a surface of ratchet **12** shown in FIG. **4**, is used to mount the centrifugal brake components. The brake components consists of; tapered pads **56** and **58** affixed to press against the surface of ratchet **12**, rotating arm **60**, which rotates about axel **70**, tapered pads **62** and **64**, (which are of the opposite angle to pads **56** and **58**), which are affixed to arm **62**, compression spring **68**, surrounding axel **70**, locating pins **72**, **74** and stop pins **76**, **78**. In normal operation rotating arm **60** which is free to rotate about axle **70** rests against locating pins **72** and **74**, and is pressed toward the surface of ratchet **12** by spring **68**. As ratchet **12** is turned clockwise with a rising load, it will tend to rotate the pads **56** and **58** under the pads **62** and **64** affixed to arm **60**. Inertia will tend to keep arm **62** from rotating. Therefore pads **56** and **58** will slide under pads **64** and **62** causing arm **60** to be pushed away from the surface of ratchet **12**, compressing spring **68**.

Stop posts **76** and **78** are positioned slightly above the plane of rotating arm **60** with one end affixed to the stationary containment and support case. As speed increases and rotating arm **60** moves farther away from ratchet surface **12** until it will contacts posts **76** and **78**, which will stop all rotation of the ratchet and attached spool. When rotation is stopped, the pressure of spring **68** on arm **60** will cause it to slide down pads **56** and **58** and return arm **60** to rest against locating pins **72** and **74**. The tension of spring **68**, the pad angles and distance above the plane of posts **76** and **78** determines the maximum rotational speed the spool can achieve and hence the rate of rise of the load.

Alternate Centrifugal Brake

An alternative method to achieve a centrifugal brake to prevent too rapid an ascent of the load can be achieved as shown in FIG. **5**. Two arms **78** and **80** are attached by pivot points **82** and **84** to a pivot **80**, which rotates about axle **11**. These are mounted about the disc of the ratchet **12** on storage spool **40**. The arms **78** and **80** are attached to springs **88** and **90** at one end. The other end is guided between two posts **92** and **94** and **96** and **98**. As ratchet **12** rotates with the loads ascent, the arms **78** and **80** will tend to extend due to centrifugal force. The springs **88** and **90** will resist this extension. As the speed increases the centrifugal force on arms **78** and **80** will exceed the spring force **88** and **90** and cause their ends to extend past posts **100** and **102**, which will stop the ratchet **12** and cable spool **40** from rotating further. When the and cable spool **40** stop rotating the centrifugal force on arms **78** and **80** will stop and the arms will retract. The choice of the spring force of springs **88** and **90** determines the rotational speed at which the arms **78** and **80** engage posts **100** and **102**, thereby limiting the maximum speed at which the load can ascend. Gravity will also affect the arms tending to pull one toward the center of rotation while the other is pulled away. This must be prevented or the force on arms **78** and **80** will be asymmetrical as the ratchet **12** rotates. Pivot **86** is used to cancel the affect of gravity. By attaching the arms **78** and **80** via pivot points **82** and **84** to the pivot **86**, which rotates freely about axle **11**, the gravitational force is cancelled out. As gravity tends to pull one arm, for example arm **78**, toward the center, the other arm **80** will be pulled away from the center causing the arm extension to be asymmetric. However tendency is cancelled his is prevented by the pivot **86**. Because the arms **78** and **80** are connected to pivot **86**, as gravity pull arm **78** toward the center its connection to arm **80** via pivot **86** will cause the other arm **80** to also be pulled toward the center. The opposite arm **80** tending to be pulled away from the center by gravity, will also via its attachment to pivot **86** cause the opposite arm **78** to be pulled away from the center by an equal amount, hence all gravitational forces are cancelled out and the arms only extend under the influence of centrifugal rotational force.

Bicycle Attachment Devices

Loads may be attached to the lifting cable shown in FIG. **2**. through a variety of means including a "J" shaped hook affixed to the lift cable **4**. Bicycles provide a unique challenge to attach as they have a large variety of shapes and angles of their cross bars. In addition modern bikes are very expensive with some costing upwards of $10,000 and composed of materials ranging from bamboo to carbon fiber. The attachment device must accommodate this wide range to hold it securely, while not causing any damage. In particular the load attachment device must hold the bicycle along its cross bar which may be angled significantly without sliding along it. The load attachment device **3** in FIG. **1** secures the load (bicycle) to the device for lifting in a manner which protects the bicycle from scratching or marring while holding it securely for the large variety of bicycle cross bar shapes and sizes. A preferred device for accomplishing this is described. The bicycle attachment device **3**A shown in FIG. **6** operates as follows. A reinforced rubber coated strap **4**A, wraps around the bicycle frame member **18**. One end is attached to the load cable **4**A shown in FIG. **2**. The other end is affixed to a clamping mechanism base **2**A shown in FIG. **6**. In operation the attachment device strap **4**A is wrapped around the bicycle cross bar frame member **18**. A gate rod **6**A closes around the strap **4**A and traps it between the base **2**A and latching notch **8**A. The rear portion of the gate rod **6**A goes under lip **16**A. When a bicycle is held in the strap **4**A, the strap will self tighten around the bicycle due to its weight, as it is raised. The gate rod **6**A is held by a notch **8**A and under lip **6**A by the forward force of the strap **4**A pressing against gate rod **6**A away from base **2**A, due to the weight of the bicycle tensioning strap **4**A. The gate rod is shaped to pass through a hole **12**A in base **2**A, and acts as a hinge. It is further shaped to go under the lip **16**A and to a handle **14**A. In this condition the bicycle can be raised by the lift cable **4** of FIG. **2**. To remove the bicycle from the bicycle attachment device **3**A, the bicycle is lowered to the floor as previously described One end of the bicycle is slightly raised, by the user, to take tension off the bicycle attachment device strap **4**A allowing the strap **4**A to be slightly loose. The handle **14**A is free to rotate about gate rod **6**A. It is affixed in a manner which prevents it from sliding away from the base **2**A on gate rod **6**A. As handle **14**A is twisted clockwise it will cause gate rod **6**A to be pulled to the right out of notch **8**A and out from under lip **16**A as its angled edge rides along lip **16**A. As gate rod **6**A to comes out of notch **8**A and out from under lip **16**A, The gate rod using handle **14**A is rotated approximately 90 degrees about hole **12**A, through base **2**A. As it rotates it will release strap **4**A from behind gate rod **6**A. This is the open position. With the strap **4**A free it is unwrapped from the bicycle frame member **18**A, freeing the bicycle for use. To reattach the bicycle to the bicycle attachment device, the strap **4**A is wrapped around the bicycle frame member **18**A, with the gate in the open position. Using the handle **14**A, the gate rod **6**A is rotated, counter clockwise about hole **12**A, in a manner such that the strap **4**A is captured between the gate rod **6**A and the base **2**A. As the gate rod **6**A is rotated counter clockwise its edge will ride along the angle of lip **10**A. This will cause the gate rod **6**A to pull the strap **4**A toward the base **2**A. As gate rod **4**A continues to rotate counterclockwise it moves to the right until it is behind lip **10**A and contacts lip **16**A, where its rotation will be stopped. As the weight of the bike is allowed to tension strap **4**A, it will pull gate rod **6**A under lip **16**A and into notch **8**A. This will prevent the gate rod **6**A from rotating further. With strap **4**A trapped between gate rod **6**A and base **2**A and rod **6**A is in notch **8**A, constitutes the attachment device closed and locked position, ready for lifting a bicycle. The weight of the bicycle self tightens strap **4** around the bike frame member **18**A. The strap material is chosen to provide a non slip, non scratching, secure attachment, which conforms to most size and shapes of bicycle frames.

Horizontal Bicycle Storage

To provide additional headroom for the storage of a bicycle when it is in its raised position, the bicycle may be attached to an alternative mooring apparatus, which allows the bicycle to be stored horizontally. The horizontal storage apparatus provides three mooring cables forming a harness 1B, as shown in FIG. 7. One end of each mooring cable is attached to the lift cable 4. The other ends are attached to brackets affixed to points on the bicycle. The brackets can be either added brackets affixed to the bicycle frame or it may consist of normal bicycle parts, such as, the bracket which holds the derailleur, which have been replaced with brackets with an additional attachment point for the mooring lines of the harness. Two of the mooring lines of the harness are attached to two fixed brackets, which are mounted to the bicycle in the appropriate positions, as described latter and the third mooring line may use the bicycle load attachment device shown in FIG. 6 or attach to a third a fixed attachment point affixed to the bicycle frame cross member 18B. The three attachment locations are; one at the pedal crank area 6B, one at the rear frame area 8B, in proximity to the rear axle, and one on the bicycle cross bar 18B, as shown in FIG. 7. The attachment points are chosen such that when a lifting force is applied by the lifting cable 4 attached to the harness, the bicycle will be lifted in a nearly horizontal orientation. The attachment points are positioned such that, as the bicycle user prepares to raise the bicycle, it is allowed to tilt to a near horizontal position determined by the harness attachment points and the length of each of its mooring cables. The attachment points and mooring cable lengths are adjusted during initial set up such that when the mooring lines are tensioned by the weight of the bicycle they position the bicycle with a slight tilt toward the rear of the bicycle and toward the lower edge of the wheels, such that it remains balanced stably between the three support attachment points. To prevent the front wheel from rotating about the steering axis when it is lifted in the near horizontal orientation, an adjustable strap 12B is affixed between the front wheel and the frame member 14B. It holds the front bicycle wheel such that it is maintained in approximately the same plane as the frame, during lifting and storage. The strap 12B may be similarly attached for a bicycle to be stored in the vertical orientation to prevent the front wheel from turning during lifting and storage and thereby provide a more compact profile for storage. The bicycle is raised in this near horizontal orientation. Loops in the cable ends, at the end of each mooring line attach to the fixed brackets on the bicycle. The brackets, which are affixed to the bicycle, are suitably covered in a soft material to prevent scratching or other damage to the bicycle. In operation after attaching the lift harness to the three points, the bicycle is allowed to lean into a near horizontal position supported by the harness. With the bicycle supported by the harness the user pulls the release cord 6 as previously described to start the lift sequence, then applies a momentary downward force on the load to cause the pawl 10 of FIG. 2 to disengage, which allows the bicycle to rise to the desired storage height, while in a near horizontal position.

Storing the bike in this near horizontal position provides greater space between it and the floor, thereby providing greater headroom, than in the case where the bicycle is held vertically. This feature is a very useful feature in a low ceiling area. The WiFi controlled release mechanism of FIG. 3 may also be used in the horizontal bike lift configuration.

Alternate Mechanism for Bicycle Storage

FIG. 9 shows an alternate mechanism for a bicycle storage device, which allows a bicycle to be lifted by a constant torque spring and pulley mechanism, from its standing position on the ground to a position at the top of the lifting device's travel for storage. A bicycle 2 or other load is attached by a load hook 3C, as shown in FIG. 9 to a lift cable 4C suspended by the device's cable pulley 5C, which is attached to containment box 15 through a shaft 8C, shown in FIG. 10A constant torque spring 7C supplies a force slightly greater than the weight of the object load (bicycle), such that the load object will rise until the maximum lift height is reached or the object reaches the ceiling. A preferred constant torque spring is available from Vulcan Springs, Inc. with offices in Telford, Pa. The object load (bicycle) is lowered by manually applying a small amount of downward force, by pulling downward on the object attached to the load hook 3C of FIG. 9. As the object load 2 (a bicycle) of FIG. 9 is lowered the pawl 9C and ratchet 10C mechanism, shown in FIG. 10, allow it to descend by rotating (in this example a counter clockwise rotation) but when the downward pull is stopped the load object will tend to rise due to the torque applied to it by the constant torque spring 7C by turning the cable pulley 5C in a clockwise direction this will cause the pawl 9C to engage the ratchet 10C and prevent the cable pulley from turning and the load from rising. The pawl 9C is positioned such that an arc from its pivot position with a radius equal to the distance from the pivot to the pawl 10C apex will intersect the circumference of the ratchet teeth, root circle. The position at which the pawl 9 stops the rotation of the ratchet 10C is where the lower intersection of the two circles occurs. This action allows the load to be stopped at any point in its travel, when the downward force applied by the user is stopped: With the pawl 9C engaged into the ratchet 10C, the object load, such as a bicycle, can be removed from the load hook 3C of FIG. 9. The load hook 3C remains at whatever height above the floor it was positioned at.

Lift cable 4C is wound around the cable pulley 5C, as shown in FIG. 10, to which the lift cable 4C is attached and connected by a shaft to the output spool 11C of the constant torque spring 7C. The constant torque spring mechanism 1 shown in FIG. 11 is comprised of a support structure 15C and a constant torque spring 7C, which is wound around two spools. The output spool 11C and the storage spool 12C, as shown in FIG. 11, which are supported by their respective axle shafts. A portion of the constant torque spring is coiled about the output spool 11C and a portion about the storage spool 12C in the reverse rotation, as shown in FIG. 2. This reversal of the winding from the output spool 11C to the storage spool 12C creates a nearly constant torque on the output spool 11C (+/−10%), which is transferred to the cable pulley 5C by the connecting axle 8C connected to the cable pulley 5C. The torque transferred to the cable pulley 5C generates a force which tends to wind the lift cable 4C about the cable pulley and thereby lift the load of the attached bicycle or other object, within the lifting limits of the torque, which is supplied by the constant torque spring 7C. The spring is designed such that the torque it generates in combination with the size of the output spool produces a force, which is slightly greater than the weight of the intended load (bicycle for example) to be lifted. The maximum lifting capability is determined by the proper choice of the spring parameters, spool diameters and the cable pulley's diameter. For a given constant torque spring, the lifting torque and thereby the load lifting capability of the device can be adjusted to suit the intended load by adjusting the diameter of the cable pulley 5C. This can be accomplished in a variety of ways, for example by replacing the spool with a suitable diameter for the load, by adding or removing a hollow cylindrical sleeve to the base cable pulley 5C to increase its diameter, or by winding a material about the spool upon which the lifting cable rides on top of, thereby increasing the effective diameter as experienced by the lifting cable **4**C. The spring mechanism provides a nearly constant torque independent of the number of turns on the output and storage spools. This creates a nearly constant force on the lift cable, which is always tending to lift the object load. To lower the load a downward force is applied by the user which overcomes the constant torque spring force applied to the cable pulley **5**C such that it unwinds the lift cable **4**C, causing the load to descend. This will wind further turns of the constant torque spring **7**C onto the output spool **11**C as the load is lowered. In normal operation the constant torque spring **7**C is coiled about the storage spool **12**C with only a few turns about the output spool **11**C. As the load is lowered, from its uppermost position, it winds an increasing portion of the constant torque spring **7**C about the output spool **11**C, which supplies torque to the cable pulley **5**C and thereby provides a force to resist the weight of the object load, attached to the lift cable **4**C, in affect counter balancing it. During lowering of the load, the pawl **9**C, is not engaged into the ratchet **10**C, attached to the cable pulley **5**C but rides on top of the teeth of ratchet **10**C. When the load reaches the desired height and the downward force applied by the user is released, the pawl **9**C will engage a tooth of the ratchet **10**C, as it tries to rotate clockwise, preventing it from turning any further and thereby any upward travel of the lift cable **4**C. This allows the load to be lowered to any desired height and removed from the load hook **3**C, shown in FIG. **9**, at any position along its travel.

To raise the load, the pawl **9**C is disengaged from its associated ratchet **10**C by pulling a release cord **14**C attached to it and simultaneously pushing down on the load. The action of pulling the release cord **14**C, puts counter clockwise tension on the pawl **9**C, but it will remain trapped in a tooth of ratchet **10**C unable to rotate clockwise. Pushing down on the load, releases the tension on the pawl **9**C, due to the constant torque spring **7**C. As the cable pulley **11**C rotates counterclockwise, the ratchet **10**C attached to it rotates with it. As the ratchet turns by one tooth counterclockwise, the pawl **9**C will come free of the teeth of ratchet **10**C. With the pawl **9**C free of the ratchet **10**C the cable pulley **5**C is free to rotate clockwise as long as the release cord is held to keep pawl **9**C disengaged from the ratchet **14**C. This disengaging pawl **9**C allows the ratchet **10** attached to the output spool **11**C to rotate clockwise, due to the force applied by the constant torque spring **7**C, which causes the load cable **4**C to be wound around the cable pulley **5**C, in turn causing the load to rise. When the load is not attached on the load hook **3**C the release of the pawl **9**C is prevented by the force of the torque, which is trying to turn the ratchet **10**C clockwise, for raising a load and thereby holding the pawl **9**C against a tooth of the ratchet **10**C, preventing it, the cable pulley **5**C and output spool **11**C from turning in a clockwise direction. This action provides a safety factor to the operation, which requires both the release cable to be pulled and the load to be pushed and or pulled downward simultaneously, to initiate the ascent. When a load is placed on the load hook **3**C it counter balances the force, on the pawl **9**C, which is tending to keep it engaged into a ratchet **10**C tooth, thereby allowing the pawl **9**C to be easily disengaged, by pivoting downward, about pawl hinge pin **26**C, when the release cord **14**C is pulled and the load is lowered by the amount of one tooth rotation of the ratchet **14**C.

Alternate Release Mechanism

In the above described release mechanism, the release cord must be pulled down during the entire time the load is being raised, in order to keep the pawl **9**C from re-engaging the teeth of ratchet **10**C. This is convenient for stopping the load at any point during its ascension. However it may be inconvenient for some applications to continuously pull the release cord **14**C as the load is raised. Therefore, an alternate release mechanism is described in FIG. **11**. In this mechanism when the release cord **14** is pulled downward it rotates the cam **27**C, which is in its up position as shown in FIG. **11**, about hinge pin **26**C, overcoming the spring force of spring **17**C, which is tending to rotate the cam **27**C counter clockwise. The cam **27**C rotates clockwise, until its bottom edge contacts the stop pin **18**C. The arm **22**C and the release lever **20**C are also rotated about hinge pins **19**C, **21**C, and **25**. The lower end of the cam spring **17**C, will rotate about hinge pin **26**C. As its lower end rotates clockwise from its position shown in FIG. **11** to the position shown in FIG. **12**, the centerline of the spring moves from the right of the hinge pin **16**C about which it pivots, to the left side of the hinge pin **26**C. Thereby changing the force applied on the cam **27**C, from tending to rotate it counter clockwise to a force, which tends to rotate it clockwise. Therefore, when the downward pull on the release cord **14**C is stopped, the cam **27**C, arm **22**C and release lever **20**C will all remain in their downward rotated positions, as shown in FIG. **12**. The pawl **9**C remains engaged in the ratchet **10**C due to the clockwise rotational force of the constant torque spring **7**C of FIG. **11**, tending to rotate the ratchet clockwise, as it overcomes the counterclockwise force on the cable pulley **5**C and ratchet **10**C exerted by the load. When the load on the load hook **3**C of FIG. **10** is lowered slightly, by an amount equal to one tooth rotation of the ratchet **10**C, the pawl **9**C will disengage from the ratchet **10**C and rotate downward about hinge pin **26**C until its lower edge contacts stop pin **26**C, stopping its further rotation but clear of the teeth of ratchet **10**C. The pawl **9**C remains disengaged from the ratchet **10**C and the load can rise without the release cord **14**C being continuously pulled. When the load reaches its raised storage position a sphere **23**C, shown in FIG. **11** affixed in the appropriate position on the lift cable **4**C, at a position above the load hook **3**C will contact the release loop **24**C on the release lever **20**C, causing it to rotate clockwise about hinge pin **19**C. This will push arm **22**C, upward causing cam **27**C to rotate counterclockwise, thereby rotating pawl **9**C counterclockwise until it re-engages a tooth of the ratchet **10**C. The spring **17**C will also have had its lower end rotated counterclockwise, causing the force it applies to the cam **27**C to return to the state where it applies a counterclockwise force to the cam **27**C. This rotates the pawl **9**C against the teeth of ratchet **10**C, as shown in FIG. **11**. With the pawl re-engaged in the ratchet the load is stopped from rising further and the load is held in the raised storage position. Pulling down on the load will cause the tip of the pawl **9**C to rotate clockwise and deflect the cam clockwise, as well, due to its resting on hinge pin **26**C. However the deflection to allow the tip of pawl **9**C to ride on top of the teeth of ratchet **10**C, as the load is lowered, is not sufficient to cause the lower end of spring **17**C to pivot far enough to change the direction of the force it applies in a counterclockwise direction to cam **27**C to clockwise.

Variations

The present invention is described above in terms of specific embodiments. However persons skilled in this art of storage devices will recognize that many alterations, additions and embodiments are possible utilizing the novel concepts described above with respect to the specific embodiments. Therefore, the scope of the present invention should be determined by the appended claims and their legal equivalents rather than the examples given.

What is claimed is:

1. An overhead storage device having a lifting range, for lifting and storing a bicycle above floor level, said device comprising:

A) a support case,

B) a cable pulley,

C) a constant torque spring mechanism attached to the cable pulley comprising:

1) an output spool and a storage spool,

2) a single constant torque spring unit wrapped partially around the output spool and partially around the storage spool, said output spool being rotatably connected by a common shaft to the cable pulley, said single constant torque spring being and adapted to-apply an approximately constant, within +/−10 percent, torque to the cable pulley,

D) a lift cable partially wound around the cable pulley and having an attachment mechanism at one end of the lift cable; said attachment mechanism comprising:

1) a clamping mechanism defining a clamping mechanism base and a latching notch,

2) a reinforced rubber coated strap adapted to be wrapped around a bicycle cross bar frame member,

3) a gate rod rotatably attached at one end to the clamping mechanism base with one end adapted to fit in the latching notch after the rubber coated strap has been wrapped around the bicycle cross bar frame member so as to trap the rubber coated strap within the clamping mechanism so that the strap will self-tighten due to the weight of the bicycle frame member when the bicycle is raised and so that the gate rod will be held within the notch by the force of the reinforced rubber coated strap pressing against the gate rod,

E) a locking mechanism; comprising:

1) a ratchet unit rotatably attached to the output spool,

2) a rotatable release arm mounted on an axle,

3) a tension spring attached to the rotatable release arm adapted to apply clockwise and counterclockwise tension to the release arm depending on positions of the rotatable release arm,

4) a release cord attached to the rotatable release arm,

5) a pawl with a latch pin attached to the pawl, said pawl being adapted to rotate in and out of the ratchet unit,

6) a flat latch spring defining a free end and a fixed end fixed with respect to the support case, said flat latch spring also defining a step, the step defining a latch point under which the latch pin may be caught to prevent the latch pin, when rotating, from rotating further,

7) a first torque spring attached to the release arm and configured to rotate the pawl clockwise and a second torque spring configured to rotate the pawl counterclockwise,

wherein the locking mechanism is adapted to permit the attachment mechanism and an attached bicycle to be lowered and locked at any desired position within the lifting range of the device, and

wherein the constant torque applied to the cable pulley by the constant torque spring continuously causes the cable, unless the cable is restrained, to be further wound on the cable pulley, and

wherein the locking mechanism is adapted to restrain rotation of the cable pulley the output spool and the storage spool unless:

1) the release cord has been pulled downward disengaging the pawl from the ratchet unit when a downward force is temporarily applied to the cable and

2) a downward force, large enough to overcome the constant torque applied to the cable pulley by the constant torque spring, is temporarily applied to the cable,

wherein the bicycle may be raised to an overhead position by upward forces provided by the constant torque spring by a user momentarily applying a downward force on the lift cable after pulling down on the release cord to disengage the pawl from the ratchet unit, and

wherein the bicycle may be lowered from the overhead position to a bicycle removal position by the user applying a downward force on the bicycle overcoming an upward force on the bicycle provided by the constant torque spring.

2. The overhead storage device as in claim 1, further comprising a centrifugal clutch for stopping rotation of said cable pulley during rapid acceleration of said cable pulley.

3. An overhead storage device as in claim 1, whereas a release cord is in the form of a loop and the loop is used as a means of raising the lift cable when the lift cable is not in use to lift the bicycle.

4. The overhead storage device as in claim 1, wherein said bicycle is horizontally attached to said cable.

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